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THE
SPHYGMOMETER,

AN INSTRUMENT WHICH RENDERS THE ACTION OF THE
ARTERIES APPARENT TO THE EYE.

THE UTILITY OF THIS INSTRUMENT
IN THE
STUDY OF DISEASE.

RESEARCHES ON THE AFFECTIONS OF THE HEART,

AND ON THE
PROPER MEANS OF DISCRIMINATING THEM CONSIDERED.

BEING

A Memoir,

PRESENTED TO THE INSTITUTE OF FRANCE,

BY

DR. JULIUS HÉRISSEON;

WITH

AN IMPROVEMENT OF THE INSTRUMENT

AND

PREFATORY REMARKS BY THE TRANSLATOR,

DR. E. S. BLUNDELL.

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P R E F A C E.

THE particular notice which Dr. Hérissou's Memoir attracted from the French and English Journalists, as well as the favourable reception which it has met with from the medical profession generally, have induced me to present to the public a translation of it, conceiving that whatever tends to the advancement of medical science ought to be extensively promulgated; and being persuaded that, among the new means of combating disease, recently pro-

posed to the world, few promise more important results than the Sphygmometer.

The first part of this essay contains a description of the form and materials of the Sphygmometer*, the manner of applying it, and a statement of the positive advantages likely to arise, from its general adoption in medical practice in preference to the touch.

In the second part of this memoir, considerable care has been bestowed to give in a condensed, yet complete form, every thing that is requisite to assist the practitioner in his investigations of the diseases

* The description of the Sphygmometer appeared to me to be so obscure, that I have taken the liberty of giving it in a more graphical and detailed form.

of the heart, and to facilitate the means of discriminating them.

In the concluding part of the work, the author has given a summary of sixty-seven cases of diseases of the heart, which he had treated, within the last six years; these cases are the more satisfactory, as in all, he was allowed to make a *post mortem* examination, and thus the value of his instrument as a means of investigating diseases of the heart was thereby confirmed or disproved; and we must regret with Dr. Hérisson, that M. Majendie, who was one of the reporters appointed by the French academy of sciences to investigate the merits of the Sphygmometer, should have carried his “delicacy” so far, as to abstain from giving a statement

of his own observations on this important subject, in consequence of his being then engaged in preparing for the press a work on the same class of diseases.

The ordinary obstacles which present themselves in a minute investigation into the nature and symptoms of several kinds of diseases of the heart, are in many instances to be ascribed to their ambiguity ; (for instance, in cases in which a transposition of the viscera has existed from infancy ;) and we have frequently the mortification of finding, that the true nature of the disease has, in the first instance, been very imperfectly understood, and we only become aware of its existence when it can no longer be concealed, and its cure is unfortunately beyond the reach of the healing art.

Should the doctrine disseminated by the inventor of the Sphygmometer become established, the important results likely to ensue will be, to advance medicine as an exact science, to lay down such rules as may lead to the formation of a correct theory of the pulse, to simplify the nomenclature of the present day, to give a greater facility to the study, classification, and treatment of those diseases to which the heart is liable, and which have hitherto been so complicated and doubtful, frequently having their existence more in books than in the head of the physician.

The important discovery of the Stethoscope has thrown considerable light on the path of the pathological inquirer into the true nature and character of the diseases of the heart and arteries ; but, notwithstand-

ing the advances that have been made in the investigations of these affections, we cannot deny that much remains to be accomplished, and the pathologist has still many perplexing difficulties to overcome, before he will be enabled to ascertain with precision the existence of the various diseases to which this organ is liable, and to avoid confounding them with others.*

In Pericarditis, for instance, even Laennec in his work admits, ‘that the information afforded by the Stethoscope is quite as un-

* A very celebrated physiologist observed to me, that when exploring the region of the chest with the Stethoscope, if it were placed at the distance of the nipple from the sternum on the right side, pulsation will sometimes be very distinctly heard, and yet no material organic change of the heart had taken place; this fact, he remarked, occurred more particularly in females.

satisfactory as that furnished by the ordinary means of examination ; for, when the contractions of the heart in a man otherwise healthy, without any perceptible cause, begin to give a strong impulse, and produce a sound more intense than in the natural state, they afford adequate grounds for presuming the pericardium to be the seat of the disease, but they cannot be considered as pathognomic of Pericarditis ; for, congestions of blood in the heart, and polypous concretions which arise therefrom, may produce exactly the same symptoms.’ Martinet observes, that this disease may be confounded with a softening of the structure of the heart, and the same author, under the head Carditis, states that ‘ Pathologists have not, as yet, been able to ascertain with sufficient precision any symptoms which enable us to indicate

satisfactorily the existence of inflammation of the substance of the heart; for, Pericarditis, aortitis, and pleuritis at the left side, are often confounded with Carditis.'

Let us hope that with the Sphygmometer, we shall be able to elucidate those points which the Stethoscope is not able to reach, and thus furnish the Stethoscopist with a powerful auxiliary in enabling him to indicate, with unerring precision, not only the seat, nature, and extent of the disease, but also the slightest disturbance in the central circulation.

It has been acknowledged by ancient as well as by modern medical writers, that there are few diseases to which the human species is liable, more tormenting than affections of the nerves; and it is a lamentable

truth, that few disorders are so little understood; for, in tracing the primary symptoms of lesions of tissue in the heart to their source, we frequently find them succeed to nervous derangement; and there seems good ground for believing, that these functional disturbances, by their obscurity and consequent difficulty of detection in the incipient stage, occasionally lay the foundation of structural change.

To the medical student, the Sphygmometer will be a valuable assistant in his daily rounds through the wards of the public hospitals, revealing to him certain peculiarities in the arterial circulation, which he is unable to detect by the touch; but, before he can appreciate these advantages, he must make himself thoroughly acquainted with the principles of the instru-

ment, and, under the direction of his professor, familiarize himself with the proper mode of applying it. He should, at different periods, take copious notes of the changes which he observes in the disease under investigation as they supervene, and afterwards carefully compare them with the description of diseases of the same nature, contained in the best works on the subject; thus, the pupil will be able to elucidate any part of the treatment which is involved in apparent obscurity.

The country practitioner will derive considerable advantage from the introduction of the use of the Sphygmometer in his practice, as it will enable him to draw out the cases which he has to transmit for consultation, with a greater degree of accuracy than heretofore.

Having given a statement of the advantages to be conferred on society by a general adoption of the Sphygmometer in medical practice, as well as the valuable addition which it promises to science, I shall now point out two serious inconveniences which will constantly obstruct the investigations of the pathologist, when using this admirable instrument.

The first inconvenience which I have experienced when applying the instrument to the wrist of the patient, and which I consider of the utmost importance, is the difficulty of steadily keeping up and retaining with the hand an unvarying maximum of pressure, sufficient to make the mercury ascend to 25° ; to accomplish which, with the instrument as invented by Dr. Hérissou, requires more than ordinary tact, and it is

to this circumstance, probably, that we are to attribute the discrepancy between the results of the minutes of the two observers, requested by the Commission of the Academy, to make their observations with the Sphygmometer on the same patient.*

The second inconvenience occurs, when the instrument is removed from the wrist of the patient, on account of the column of mercury not readily descending into the reservoir, but lingering for several minutes at the bottom part of the glass tube. This defect, which is probably owing to the quicksilver having acquired an increased temperature during its contact with the skin, obliges the operator to wait several minutes, until the mercury has returned

* Vide ATHENÆUM, No. 373, Dec. 20, 1834, p. 922.

to its former temperature, and sunk into its original station, before he can close the stop-cock, and thus shut out the communication between the reservoir and the glass tube; if this precaution be not attended to, a portion of the metal is liable to escape by the aperture at the top of the tube, and the accuracy of the instrument is thereby destroyed.

To obviate the first of these inconveniences, I have succeeded, after repeated experiments and trials, in an invention, which transfers the pressure to an apparatus, instead of confiding it to the hand, and by which the operator can increase or diminish the pressure, as the case may require.

By the aid of the above improvement, another most important result is obtained,

for, as the Sphygmometer is firmly fixed in a vertical position over the artery, the hands of the practitioner are perfectly at liberty to note down any phenomena which may arise.

The improvement which I have made in the construction of the Sphygmometer, in order to avoid the second inconvenience, consists, in placing the stop-cock nearly an inch higher, as close as possible to the insertion of the capillary glass tube into the stem, so that, the instant the instrument is removed from the pulse, the operator turns the stop-cock, and the mercury is secured.

E. S. B.

18, *Lower Seymour Street,*
Portman Square.

TO THE

INSTITUTE OF FRANCE.

GENTLEMEN,

AFTER having made several more or less satisfactory trials, which however were sufficiently conclusive to convince me of the possibility of finally succeeding in the attempt, I resolved to have an instrument contrived, which should render every action of the arteries apparent to the eye. The difficulty was to find an artist of sufficient ability to realize my ideas ; I had however the good fortune to meet with a very ingenious and clever young mechanician,

Mr. Paul Garnier, who has already obtained great distinction for his many inventive improvements in watchmaking, and who kindly proffered me the assistance of his talents. His skill is indeed equal to his genius, and the Sphygmometer, which I have this day the honour to lay before you, is as much Mr. Garnier's work as mine ; it is in his, as well as in my own name, that I submit this instrument to your approbation.

I shall now describe our instrument, and the manner in which it is applied ; I shall afterwards point out its utility to the medical profession, and conclude with a statement of the results of my investigations in diseases of the heart. I indulge a confident hope that, in this clinical part of my memoir, you will find grounds for thinking that my labours in this respect are not altogether destitute of advantage to medical science.*

* Dr. Poiseuil has published his researches on the force of the aortic heart. I had no knowledge of this memoir, until long after I had invented the Sphygmometer, which, however, bears no similitude to the instruments used by the Doctor in his experiments upon animals.

The instrument to which I have given the name of Sphygmometer, consists of a glass tube, three inches and a quarter in length, and two-twelfths of an inch in diameter, graduated in front, and having a slip of coloured paper placed at the back with the graduated figures marked on it ; the end of this glass tube is inserted into a steel stem, one inch and a quarter long, which is terminated at its base, by a hemi-spheroidal steel cup, three quarters of an inch in diameter, and two inches and one eighth in circumference, similar in form to an inverted tea cup, which is closed with a piece of gold-beater's skin stretched over its mouth, and confined by a rim in the same manner as parchment is secured on the head of a drum. All communication between the hemi-spheroidal cup, and the capillary duct of the stem and glass tube, is intercepted at will by a small stop-cock.

There is in this hemi-spheroidal reservoir a certain quantity of mercury, which, whenever the instrument is properly applied in the course of an artery, receives and represents its action in the transparent tube. The same instrument on a larger scale serves to explore the heart.

You will observe that the capillary duct, the hemi-spheroidal cup, and the quantity of mercury being the same in all Sphygmometers, they all possess the same power, and afford an identical measure of the pulse.

When the pulse of an individual is to be examined, he may be seated or reclining on a couch; if he be seated, the physician places himself before the arm, the artery of which he is going to examine, and steadies this arm upon his left hand, or on his thigh, or on the arm of a chair; he holds the instrument by its base between the thumb and the index (fore) finger of his right hand, and applies it over the course of the radial artery in such a manner, that the artery shall correspond, as exactly as possible, to the centre of the reservoir. By pressing the artery (in the way above alluded to) with the right hand, the physician endeavours to discover the maximum of its impulse; and having ascertained this, he presses with the end of his thumb and index finger, upon the lateral parts of the artery, whose action is then transmitted to the column of mercury, which thus appears a mere continuation of the artery.

If the individual be confined to bed, the physician takes his station opposite to the patient's arm which he holds in his left hand, whilst his right hand is occupied in the same way as when the individual is seated.

As I have now to speak of the qualities of the instrument, I fear that on my using this expression you will be apprehensive that I am going to overrate its merits with parental fondness. But banish your apprehension ; I will merely state of what service the Sphygmometer has been to me ; and I leave to your profound sagacity, the task of anticipating the services which it may render.

Its positive advantages are these : when placed over the anterior region of the thorax corresponding with the heart, the Sphygmometer reveals to the eye of the physician all the movements of this central organ, and when applied to an artery it indicates all the movements of the pulse.

Ought the Sphygmometer to be preferred to the touch for the purpose of appreciating the strength and rhythm* of the pulse ?

* I have retained this word as conveying more accurately than any other which we possess the idea

To solve this important question, on which the fate of the Sphygmometer depends, let us first examine the value of the touch relative to the pulse, and consider without prejudice what may be expected from this means. The first circumstance which strikes me is the diversity of sensation in different individuals; to be the same in all, the conditions of the organ of touch should be invariably the same in all medical practitioners. But it is quite the reverse; the hands are either young or old, the skin is either delicate or coarse, they are warm or cold, practised or inexperienced, &c. &c. Any one of these circumstances is sufficient to modify the perception of each individual physician; the judgment of medical men must therefore vary, since every thing is dissimilar either in their sensibility or in the conditions which might produce its uniformity.

As a means of exploring the pulse, the touch can be useful only to the physician who maintains its delicacy and acuteness, by a careful

which it is intended to express, viz. proportion of both strength and interval.

E. S. B.

observance of the conditions on which these qualities depend, and by its constant exercise. But is the touch an infallible and correct guide even for him, who is accountable to none but to himself for his sensation, and can the memory of a sensation, which was experienced the day before or several days ago, be abundantly accurate to allow of any exact comparison? We do not hesitate to answer in the negative; and if our opinion be consistent with truth, how is it possible, with the assistance of the touch alone, to appreciate the changes which the pulse undergoes during the course of a disease?

Suppose, for instance (not to load your memory with the various anomalies occurring sometimes in a healthful as well as in a diseased state), that, one day you find the pulse of your patient, strong, regular, and equal, and on the next day you observe a slight change in the action of the artery, be it either stronger or weaker—will you, granting it were possible to ascertain such slight variations, be able to determine the amount of the augmentation or diminution of the pulse and the nature of its rhythm? No, you

cannot possibly do so, and supposing even your memory to be excellent, and your presence of mind imperturbable, all you can say amounts to this : the pulse is a little more or less strong ; its regularity is no longer the same ; but in all these observations of yours there is nothing positive or exact ; you are aware of a change without being able to determine it with strict accuracy, and yet, it is only from correct and precise observations, that the best information is obtained in the practice of medicine ; you thus run the risk of not availing yourself of the advantages which such observations might have afforded you, and your patient may fall a victim to the obscure results of the most attentive examination.

If there be a consultation of physicians, the same diversity of opinion prevails, and the same perplexity. One doctor finds the pulse strong and regular ; another pronounces it to be moderate, but he has remarked a slight degree of inequality and irregularity ; a third has found the pulse quick ; a fourth has noticed its intermittence ; and as the consulting physicians do not agree, this divergency of diagnosis must

naturally produce a difference in the mode of treatment. The relatives of the patient, and the patient himself, who, but too frequently, witness these previous and unavoidable debates (the prudence of which may well be questioned at all times), lose confidence in those whom they had called in for their relief, and it will be fortunate if discouragement and apprehension do not aggravate the evil.

Having thus briefly adverted to the insufficiency of the touch in the examination of the pulse, I now may aver, that it cannot be supplied by any other of the senses in determining the form, density, or suppleness of the arteries, and that the instrument, the application of which I am about to describe, would be of no use without the touch, and can only be of service in conjunction with it.

UTILITY OF THE INSTRUMENT.

A. Every medical man of experience knows, that the circulation of the blood exhibits many anomalies, and that some of them are so far removed from the natural type, that if they did not coincide with perfect health, we might feel inclined to consider them as symptoms of organic diseases of the heart; and what is very remarkable, all these anomalies disappear when the health is deranged, and the pulse then resumes the physiological qualities which are observed in mankind generally. Nay, more; the physician is never perfectly certain of having effected a cure but when those phenomena return which might have induced him to suppose a pathological state. This observation had been made without the assistance of our instrument, but divested of that exactness which is so much to be desired; and many individualities of pulse (if I may be allowed the expression,) have never been noticed for want of a convenient, accurate, and faithful mode of ascertaining them. You will see by and by, that the Sphygmometer reveals

to the observer some peculiarities which the touch leaves unnoticed; but adverting barely to the most ordinary cases, this instrument is of essential advantage to obtain correct information of the state of the pulse in persons whom one may be called to attend at a future time. The derangements of a pulse must unquestionably be much better appreciated when its previous habitual disposition is accurately known. Hence, the first advantage of the Sphygmometer is, to enable the physician to write down in his note book, an exact description of the state of the pulse during health, of all those whom he is likely to visit as patients. It is not difficult to perceive the advantage which may be derived from such notes whenever the health of those persons becomes deranged. One single example will suffice to point out the eminent utility of such preliminary information.* Mr. M. a gentleman thirty years

* It is unnecessary to remark that such descriptions of the pulse ought to be noted down as often as the progress of age, and other circumstances which may produce a sensible variation in the circulation of the blood, require it.

of age, in perfect health, had his pulse examined in the morning ; it exhibited to the Sphygmometer 10° of elevation, beat 60 times per minute, and was regular, equal, supple, &c. This gentleman fell sick, his pulse now beat 70 times per minute, it rose to 12° of elevation, it was no longer equal, and the time intervening between each pulsation was no longer regular ; the pulse was become hard. On comparing these observations with his former ones, the physician is obviously enabled to determine at first sight, and with rigorous exactness, on what side the circulation is directly or sympathetically diverted from its physiological state. The constant efforts of the physician will now be directed to bring the pulse back to its normal state, by attending to the observations noted down during the health of the patient, and comparing them with those furnished by a state of disease.*

* I attend several persons whom a disposition to apoplexy subject to frequent attacks of cerebral congestion ; I frequently examine their pulse ; whenever I observe that it exceeds the degree of impulse necessary to the equilibrium, I order leeches to be applied, or a

If the pulse has been at all times considered as the unerring mariner's compass of medical men, I hope that this metaphor will now become a reality.

B. The Sphygmometer becomes eminently useful, when employed on hospital patients in hospitals appropriated to medical instruction. The instant the professor has fixed the instrument on the arm of a patient, the pupils look, and attentively follow the circumstances which he may think proper to point out; they thus judge with their own eyes, instead of relying only on the word of the teacher, for their touch is not yet sufficiently expert to authorize any reflections on their part, in case the result of their examination should not coincide with that of the professor.

certain quantity of blood to be drawn. I have noticed what loss of blood suffices to bring the pulse back to its normal state. With this precaution and the accuracy of these means, my patients, who formerly were seated on a volcano, give themselves up to the enjoyments of a tranquil life with perfect security, and are no longer subject to attacks.

C. At a consultation, every one of the medical attendants may apply the instrument in his turn, and exhibit it to all, so that each may make himself sure of what he had observed when he was merely looking on.

D. Hitherto, narratives of cases for the purpose of medical consultation, could only afford approximative information on the circulation of the blood of a patient, who, at a very great expence, applies to a distant physician of celebrity. Hence, little stress is laid upon such information, and scarcely any attention is paid to the statement of the attending physician. A far greater degree of accuracy may now be introduced into such a correspondence; the instrument being the same every where, the measure obtained at St. Petersburg will be perfectly understood at Paris.

E. The changes occurring during the course of a disease, or during or after the employment of any particular remedy, may be noted down and communicated with accuracy. The physician who calls but once a day, or every other day, will

be enabled to appreciate the effect of the remedies which he has prescribed, and consequently adopt a proper modification, or a complete change, of the therapeutic means which he may have employed.

But I will not proceed any farther in the enumeration of the advantages which may be derived from the use of the Sphygmometer; I barely intended to set down a few guide posts in the new road on which I travel; and I shall deem myself fortunate, if my professional brethren feel no reluctance in avowing, that they are under some obligation to me, for affording them the means of going on more commodiously, on the same road, than I did on opening it. With perseverance, good faith, and the concurrence of all who cultivate the natural sciences, we shall possibly one day obtain a complete theory of the pulse, the absolute want of which is still felt in medicine. It will save from many errors those who are engaged in medical pursuits.

I now lay before the Academy an abstract of my investigations in the diseases of the heart. I have devoted six years of study to the researches of which I offer you a summary account. I

indulge the hope that my labours will be of service in the diagnosis of those diseases, and that they will, in some degree, exhibit proof of the advantage which medicine is to derive from means calculated to raise it to the rank of an exact science.

DISEASES OF THE HEART.

These diseases are numerous ; but the more serious derangements of the heart are less common than they generally are supposed to be. The erroneous opinion which prevails in this respect, arises from the extreme variety of the sympathetic modifications of this organ which frequently disturb its functions. These derangements may continue for a very great length of time without any lesion of tissue. Most of those who have written upon this branch of medical science affirm, however, that next to the lungs, the heart is of all the viscera that most frequently attacked with organic disease. I am not of their opinion. Corvisart and Laennec, Bouillaud, Kreysig, Burns, &c. &c. unquestionably have thrown much light upon the diagnosis of the affections of the heart ; but of what utility are their labours if their only result is, that they afford the means of ascertaining a desperate stage of the disease for which medical science

has scarcely any alleviation? Indeed, in spite of all our knowledge, of all our investigations, and of all our exploratory processes, we are unable to mark and to distinguish any organic disease of the heart, before it has reached a point beyond the resources of the medical art.

By the aid of my instrument I can detect, *ab ovo*, any the slightest derangement in the circulation of the blood, and I think that it is not then impossible to impede the developement of the disease with which the principal organ is threatened. The first symptoms of lesions of tissue frequently are nothing but nervous derangements; and without adopting, for the explanation of this pathological phenomenon, one doctrine preferably to another, I have clearly perceived that most cases of hypertrophy, induration, vegetation (excrecence), and contraction, have had their beginning in simple rhythmical aberrations.

I will not enter upon the examination of this proposition; it is sure of the ready assent of every conscientious medical practitioner. The limits of a memoir preclude a discussion, the developement of which would fill half a volume.

Agreeably to my promise, I will content myself with quoting facts. Science sets a high value on facts, and justly deems them superior to the persuasive power of logical deductions.

It is on percussion, auscultation, mensuration, and the signs furnished by the whole of the organism that medical science has hitherto relied to arrive at the discovery of the different organic diseases which may affect the heart. But all these means of investigation are often not to be depended upon ; I shall review them elsewhere, and show that they hardly ever detect the evil but when it is no longer possible to overlook it. That they are insufficient to discover and to determine an organic disease of the heart, especially in the outset, will be clearly shown.

I may be here allowed to state rapidly the causes which interfere with the precision of those means.

1. The different sounds produced by the two sides of a healthful heart are not constantly the same in all individuals.

2. The cause of this difference rests on circumstances which cannot always be appreciated. Such are a larger quantity of fat in the parietes of the thorax, tubercles in the lungs, bronchial dilatations, &c. &c. &c. ; 3. different pathological states of the heart produce the same sound ; 4. and, what is of much more serious consequence, the nervous affections of the heart may exhibit all the symptoms which percussion and auscultation furnish in organic diseases.

5. Mensuration, which is only an accessory means, and which can barely be ranked with the other signs derived from percussion, auscultation, the *facies* (external appearance), and concomitant phenomena, is of no value excepting in those extreme cases when the excessive enlargement of the heart raises the ribs and is beyond the possibility of being cured. I think the examination of the pulse best calculated to dissipate the obscurity which prevails in the numerous means suggested to clear up the diagnosis of the diseases of the heart ; but the touch used in this examination

has not that rigorous exactitude which is to be desired, and is besides insufficient to enable us to appreciate all the evolutions produced by a diseased or deranged heart. It therefore is again by the Sphygmometer, with which we can observe any the slightest act of the arterial circulation, that we shall be able to study and compare the normal state of the pulse with its pathological one. The rhythm of the arteries is not, it is true, the same in all men ; but it will be more easy to note it down by means of this instrument than to keep an account of the different sounds produced in the Stethoscope, supposing even that the attempt to express such sounds by musical notes could succeed.

Besides this advantage, the Sphygmometer possesses the property of revealing some arterial actions, which are characteristic of certain lesions of the heart ; I, therefore, entreat the Academy to bestow all possible attention in verifying my observations. I solemnly promise to acknowledge my errors ; and if, on reviewing what I have seen, I should chance to make fresh

discoveries, rest assured that I shall be happy to insert them in the work which I am preparing, and for the publication of which I only await the favourable opinion of the Academy.

THE RIGHT SIDE OF THE HEART.

Contraction of the right auriculo-ventricular Orifice. — Whatever be the nature of the obstacle, the dark blood arrives with difficulty in the lungs, and we then observe the following phenomena:—Sensation of oppressive weight in the epigastric region ; oppression ; difficult digestion ; pains, which are more or less protracted ; the movements of the heart are feeble ; the pulse is small, irregular, unequal, intermittent, and at times imperceptible ; the liver often acquires a considerable size ; the superior members become infiltrated, and afterwards the inferior members, and the patient dies after a protracted and painful agony. At the autopsy

we commonly find a very considerable dilatation of the auricle. In the contraction of the right auriculo-ventricular orifice the Sphygmometer presents this peculiar phenomenon: the column of mercury does not always descend to the point from whence it started, or it requires two intervals to reach that point; it is surprised near the middle by an incidental impulsions which divides it.

Ventriculo-pulmonary Contraction.—A great many of the phenomena which we have just been observing in the auriculo-ventricular contraction are discovered in the ventriculo-pulmonary contractions, with this difference, that as the ventricle makes considerable efforts to overcome the obstacle opposed to the passage of the blood into the pulmonary artery, it produces in the heart all those movements which we are accustomed to denominate palpitations, which are extremely violent, and in no relation whatever with the action of the artery. Hence the pulse is feeble, trembling, agitated; it presents the same sphygmometric signs. Such lesions may terminate

in two very different ways, and they then give rise to two organic alterations, which, however, are merely the consequence of the mechanical cause of the primary disease. If the obstacle be inconsiderable, and its development slow, the multiplied action of the ventricle increases its nutrition, and you have an hypertrophy, and this hypertrophy brings on a pulmonary apoplexy, or an overwhelming hæmoptisis ; if, on the contrary, the obstacle have quickly acquired a considerable degree of force, it causes an aneurism, a true dilatation of the ventricle, the parietes of which are rapidly thinning, and its rupture is unavoidable, unless the patient be previously cut off by a hydrothorax, or by a general infiltration, the inevitable consequence of a deficient circulation of blood in the lungs. We cannot admit of the existance of any hypertrophies of the right ventricle, and of the auricle of the same side, without previous contraction ; we never met with any isolated ones, they are always attended with vegetations or valvular indurations, as well as with either an auriculo-ventricular or ventriculo-pulmonary contraction of one of the orifices.

THE LEFT SIDE OF THE HEART.

Left auriculo-ventricular Contraction.—A continual dyspnœa ; considerable oppression at the least exercise rather violent ; the face is of a violet colour, chiefly about the lips, the nose, and the cheek-bones, which are commonly covered with varicose vessels. The movements of the heart are soft ; the pulse is feeble, irregular, intermittent, unequal, but much more so than in contractions of the orifices on the right side ; and I find a satisfactory reason for it ; in the chemical difference of the blood which reaches the ventricle. Indeed, if the blood arrive slowly into the lungs, their action is diminished ; if, on the contrary, the blood get there with facility, the action of the lungs is increased. In the first case, the blood being less oxygenated, and consequently less stimulating, imparts but a moderate activity to the left cavities ; in the second case, this activity, on the contrary, will be very great, for the blood will have regenerated itself in a more easy respiration, and the action which it exercises upon the left cavities will there produce very considerable activity, particularly if it experience any obstacle in its pas-

sage ; the consequence as regards the pulse in that case is a greater irregularity ; it also may happen that the left ventricle ceases to act until it has been able to admit a certain quantity of blood. Under both circumstances, the arteries are almost empty, and this state is clearly proved by their sinking under the sphygmometric column which descends below its level, in the proportion of one, two, and even three degrees, according to the volume of the explored artery, and the power of the obstacle which opposes the passage of the blood into the left ventricle.

Ventriculo-aortic Contraction.—This undoubtedly is the most frequent of all contractions, as is proved by the numerous concentric and excentric hypertrophies of the left ventricle and its dilations. Among the causes which provoke and produce these organic lesions, we must assign the first rank to whatever opposes the passage of the blood in the aorta ; lively or concentrated moral passions ; excess of alimentation increases or compresses the action of the heart, the consequence of which is an increased nutrition of the organ, or a forced excitement of its valves and orifices,

and you then have a primitive or secondary hypertrophy, a primitive or secondary dilatation ; but we will here attend only to ventriculo-aortic contractions ; let us see what are the phenomena by which they are accompanied. The oppression is greater than in the other contractions, the anxiety more horrible, and the other symptoms, which we have described, of a more decisive character ; the heart is violently agitated ; its incredible and almost constant efforts produce inexpressible anguish, the patient no longer breathes, he is smothered, and death menaces him every moment. The pulse is generally abrupt, but its impulsions are imperfect or undeveloped ; it is irregular, unequal, frequent, intermittent, and sinks every instant ; the Sphygmometer again reveals the signs of the vacuity of the arteries in a very remarkable manner. The autopsy almost always shows, that a ventriculo-aortic contraction is attended with hypertrophy, or a dilatation of the ventricle.

Hypertrophy of the heart without any contraction of the Orifices.—A strong and deep

pulsation of the heart, vertigoes happening chiefly after rest, hot flushings of the face on the least moral agitation, oppression on the most trifling exercise, &c. ; the pulse is regular, but unequal in its contractions ; it presents this anomaly, that the column of mercury, after having been elevated to a certain number of degrees, we will say 3 or 4, ascends suddenly by intervals to 8, 10, and even 15 degrees. A simple hypertrophy of the left ventricle of the heart is constantly exhibiting this peculiar character of the pulse. The dilatation of the left ventricle and of its auricle, presents the same Sphygmometric signs as those of the auriculo-ventricular and the ventriculo-aortic contractions. Auscultation, percussion, mensuration, and the examination of the other vital functions will serve to distinguish advanced organic lesions from the contractions or vegetations which are beginning to develope themselves.

This is a summary of my Sphygmometrical investigations of the organic diseases of the heart ; but on closing my observations I beg leave to add, in support of what I have written, an enumeration of the divers facts which I have observed.

ORGANIC LESIONS.	Character of the Pulse, and Sphygmometric Signs.	NECROSCOPIC EXAMINATION.	OBSERVATIONS.
Auriculo-ventricular contractions at the right side of the heart, and auriculo-pulmonary contractions. — 22 cases.	Small, irregular, unequal, intermittent, and at times imperceptible. The column of mercury does not descend to the point from whence it started, or descends to it only in two periods. Near the middle it is surprised by an incidental impulsion.	Contractions of various kinds, and dilatations of the auricle and ventricle in a more or less forward state. A little hypertrophy was observed in the right ventricle of four individuals.	In eight of these patients, auscultation furnished only a slight <i>bruissement</i> . In six, the <i>bruit cataire</i> was distinctly marked; in the other eight, there was no abnormal sound. Oppression, and a more or less decided alteration of the features and colour of the face, were the only symptoms which might have raised any suspicions of the disease. Four patients died of pulmonary apoplexy; the rest in a state of general infiltration.
Auriculo-ventricular contractions on the left side of the heart, and ventriculo-aortic contractions. — 27 cases.	The pulse is feeble, irregular, intermittent, unequal, but much more so than in the contractions of the orifices on the right side. The column of mercury in the Sphygmometer descends below its level, 1, 2, and even 3 degrees, according to the importance of the obstacle.	In twelve cases the heart was not affected with hypertrophy, but merely dilated. In the other fifteen there was a beginning of hypertrophy of the left auricle and ventricle.	In the first twelve, the pulse was extremely feeble; the patients died of hydrothorax, in a state of general infiltration. Of the remaining fifteen, eight sunk under hæmoptysis, five died of various affections of the lungs, and two of cerebral hæmorrhage. The pulse of these fifteen patients was hard, frequent, and brusque, but offered only a very inconsiderable development.

ORGANIC LESIONS.	Character of the Pulse, and Sphygmometric Signs.	NECROSCOPIC EXAMINATION.	OBSERVATIONS.
<p>Hypertrophy of the heart, without any contraction of the orifices. — 18 cases.</p>	<p>Pulse regular, but unequal in its contractions. It presents this anomaly, that the column of mercury, after having ascended a certain number of degrees, we will say three or four, rises suddenly by intervals up to eight, ten, and even fifteen degrees.</p>	<p>The autopsy of eighteen individuals, in whom I had observed the stated Sphygmometric sign, showed a concentric or excentric hypertrophy of the left ventricle, without any contraction of the orifices.</p>	<p>In those patients who laboured under a concentric hypertrophy, the pulse had not the same developement as in excentric hypertrophy, but it presented the same character of inequality in its contractions. The signs derived from auscultation occurred in eight cases; in all the others they were so feebly marked that it would have been impossible to recognize an advanced lesion of the heart by those signs.</p>

CONCLUSION.

Whenever the action of the heart is deranged, and whenever, on examining the pulse with the Sphygmometer, none of the signs are observed which characterize one or more of its different organic lesions, we are warranted to hope that the rhythmical derangement proceeds from other causes than from lesions of tissue. These causes must then be sought for in the affections of organs which act sympathetically upon the centre of circulation.

The treatment will be regulated by the proper discrimination of these causes. I can safely aver that many affections, considered as organic under the ordinary examination, but judged very differently when my means of investigation have been employed, under the influence of a rational treatment.

In a work *ex professo* on this subject, I shall have an opportunity to show by very numerous

anatomical facts that the alteration of the organs which are in direct relation with the heart, are almost always coincident with its own lesions ; a circumstance which admirably explains the disturbed state of the circulation, and the consequent organic diseases of the heart itself, the centre of that circulation.

Health is nothing more than a state of equilibrium, if one organ happen to languish, or if, being over-excited, its action be increased, it does not suffer alone, but every organ under its more or less direct influence, is more or less severely injured by its lesion.

We have heard it repeated to satiety that the passions of the mind are the most common causes of the diseases of the heart ; but who will dare to affirm that certain dispositions of this organ are not in themselves the most powerful motives of those passions ? Who can doubt that a voluminous heart disposes its possessor to irritations of the brain ? But again what a number of furious erotic and other monomanias, which, when ended in death, and after an afflicting duration of several years, have not been found coincident

with an organic lesion of the heart! Violent passions then are not sufficient to produce the organic alterations of the heart. Hypertrophies of the left ventricle, on the contrary, produce cerebral irritations, which may rise from a simple gust of anger to the ravings of a maniac, and from a mere congestion, to an overwhelming apoplexy.

The individuals in whom we meet with dilations and contractions of the heart, generally are phlegmatic and indolent; almost all of them are addicted to the pleasures of the table. These two conditions, when attended with an overenergetical hæmatisation, soon furnish a quantity of blood, which is no longer proportionate to the general vascular system; and the most obvious consequence is, that the muscular action of the heart is increased, that it then becomes irritated, or that its cavities are distended.

The diseases of the heart most commonly have their origin, in my opinion, in an alimentation disproportioned to the bodily exercise of the individual, or in an exercise pursued beyond the limits of his strength. Wherever the influx ex-

ceeds the outgoings there is obstruction, and the reservoirs are either deteriorated, or dilated, or they burst. I ought perhaps to lay more stress upon these ethiological considerations, since they may lead to therapeutical applications of the highest importance, but I am forced to abridge my discourse, and conclude it with repeating, that an incipient disease of the heart appears to me capable of being cured, and that during the six years which I have devoted to an attentive study of the diseases of this organ, I have often chanced to notice them, when they could not possibly have been suspected, by merely employing the ordinary known means. I have followed their development, and beheld them with sorrow arrive at the point where they are past remedy. The patients had rejected the advice of the medical men who enjoined some few privations, and when the assistance of the latter was claimed, their art could no longer afford any efficacious aid.

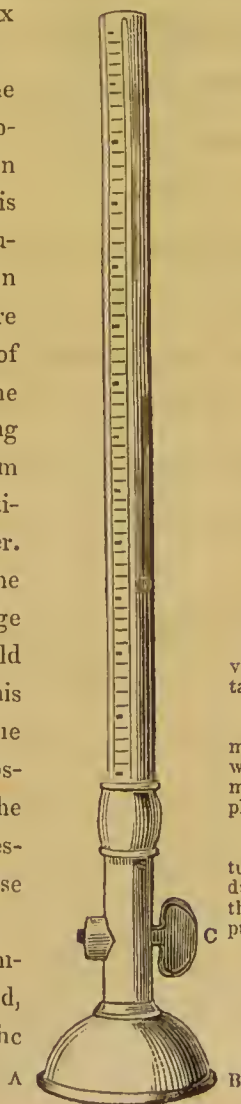
SPHYGMOMETER.

MANNER OF APPLYING
THE INSTRUMENT.

The base A and B of the instrument is to be held between the thumb and the index (fore) finger.

This base is applied over the course of the radial artery, opposite the styloid apophysis, on the spot where the pulse is commonly felt. The instrument is gradually pressed on the vessel, and particular care is taken to observe the force of impulsion communicated to the mercury. When, on comparing the contractions, their maximum has been obtained, the investigation is not carried farther. The operator then rests upon the radius, using the inferior edge of the two fingers which hold the instrument, and makes his observations. The whole of the operation must, as far as possible, be so managed, that the base of the instrument corresponds in the centre to the course of the artery.

When the observation is completed, the stopcock is turned, to prevent the escape of the mercury.



A B is the reservoir which contains the mercury.

C the cock, which must be turned when the instrument is to be applied.

D is the glass tube, which is graduated, to mark the force of the pulse.

Suppose that at 10° of pressure you have an impulsion of two degrees ; that at 15° of pressure you have an impulse of four degrees, at 20° of six, at 25° of ten, and that at 26° , 28° , or 30° , you obtain only eight degrees, it is evident that the maximum of impulsion is ten degrees, since above and below 25° of pressure, the impulse is less.

The same operation is repeated on all the points where the radial artery is visible, and stops at the point which yields the highest degree of impulsion.

EXTRACT OF A REPORT MADE TO THE ACADEMY
OF SCIENCES, RELATIVE TO THE SPHYGMOME-
TER OF DR. HÉRISSE, BY MESSRS. MAJENDIE
AND SERRES.

“ Your Reporters have bestowed particular
“ attention upon the examination of the instru-
“ ment presented by Dr. Hérissé; they have
“ submitted it to various trials, and it is, only
“ after having made and repeated different experi-
“ ments, that they now report the results at
“ which they have arrived.”

Here follows the description of the instrument,
and the manner of applying it.

The Reporters then state :—

“ There are certain precautions to be taken,
“ and some difficulties to be overcome in order
“ properly to apply the instrument to an artery.
“ If the pressure be too great, the mercury, it is
“ true, rises high in the tube; but the artery

“ being compressed, the course of the blood is
 “ slackened or even impeded, and the pulsations
 “ are no longer transmitted to the column of mer-
 “ cury. On the other hand, if the pressure be
 “ not sufficiently strong, and if the base of the
 “ instrument be not exactly applied to the vessel,
 “ the pulsations of the pulse are but imperfectly
 “ perceived in the tube ; it is thus only after re-
 “ peated trials that the maximum of the impulsion
 “ can possibly be obtained in the instrument.”

M. Majendie could have wished the instru-
 ment more to resemble a thermometer. How-
 ever, he afterwards expresses himself thus:—
 “ Be this as it may, whenever the difficulties in
 “ the application of the Sphygmometer are over-
 “ come, when the pulsations are freely transmitted
 “ to the mercury, the metal is distinctly seen
 “ rising in the tube at every contraction of the
 “ left ventricle ; and all the shades of this con-
 “ traction, such as the irregularity of the intervals,
 “ the duration and the force of the contraction of
 “ the heart, are immediately perceived in the
 “ tube, and afford a novel and interesting sight
 “ to the physician, who now sees with his own

“ eyes, what hitherto he has more or less imperfectly appreciated by his touch.”

Finally, the reporters recommend that the thanks of the Academy be presented to Dr. Hérisson, and Mr. Paul Garnier, watchmaker.

(Signed) “ SERRES and MAJENDIE,
“ REPORTERS.”

“ The Academy adopts the conclusions of the
“ Report.

“ Certified conformably to the original, by the perpetual Secretary for the Natural Sciences.

(Signed) “ FLOURENS.”

N. B.—M. Majendie has not thought proper to make any observations on the second part of Dr. Hérissou's memoir, which is entitled—"Investigations of the Diseases of the Heart, and the Means of discriminating them." It is well known that M. Majendie is himself engaged in the study of the said diseases, and it is doubtless from delicacy that he has abstained from making any remarks on this subject.

Since translating the above, I have observed in the *ATHENÆUM* of December 20th, 1834, p. 922, a notice of the report of Messrs. Majendie and Serres on the Sphygmometer, in which it is stated that these gentlemen gave it as their opinion, that its results are not more precise than those of the ordinary mode of feeling the pulse, since, "having caused two persons both equally skilled in the use of the Sphygmometer, to apply it successively to the radial artery of the same individual, and to write down separately the indications given by the instrument, the results obtained differed materially." I am entirely ignorant why Dr. Hérissou has not given this

objection in his abstract of the report, but however this may be, it will be seen from the introductory page (xiii.) that a similar objection had already occurred to myself, and that I have as I conceive effectually obviated it by the improvement which I have made in Dr. Hérissou's instrument.

E. S. B.

DESCRIPTION

OF THE

IMPROVEMENTS OF THE INSTRUMENT.



The annexed drawing is a representation of the Sphygmometer, which I obtained from Mr. P. Garnier, through the kindness of a friend visiting Paris. On comparing it with the drawing given by Dr. Hérissou in his Memoir, I found it to differ one inch and a quarter in length, and one-twelfth of an inch in diameter; and the hemispheroidal cup and stem, were made of ivory, instead of steel. As Dr. Hérissou observes in p. 14, that the instrument being the same every where, the measure obtained at St. Petersburg, will be perfectly understood at Paris, I cannot account for this discrepancy. I have added my improvement of the situation of the stop-cock to this drawing, and likewise a statement of the exact dimensions of the instrument.



MEASURE OF THE DRAWING OF DR. HÉRISSE'S INSTRUMENT.

	Inch.		
Glass tube.....	3	$\frac{2}{8}$	
Stem to cup	1	0	
From apex of cup to base	0	$\frac{2}{8}$	$\frac{1}{16}$
	<hr/>		
	4	$\frac{4}{8}$	$\frac{1}{16}$

MEASURE OF P. GARNIER'S INSTRUMENT.

Glass tube.....	4	0
Stem to cup	1	$\frac{2}{8}$
Apex to base.....	0	$\frac{4}{8}$
	<hr/>	
	5	$\frac{6}{8}$

DISCREPANCY.

Glass tube	0	$\frac{5}{8}$	
Cup	0	$\frac{1}{8}$	
Stem	0	$\frac{3}{8}$	
	<hr/>		
Total.....	1	$\frac{2}{8}$	longer.
Diameter.....	0	$\frac{1}{16}$	more.

DESCRIPTION OF THE APPARATUS.

It was my intention to have annexed a drawing to the description of the Apparatus which I have invented, to obviate the inconvenience which occurs, when the Sphygmometer is applied to the wrist of the patient (*vide* p. xiii. of the Preface); but, as considerable delay and expence would necessarily be incurred, greatly beyond the limits of the work, I have contented myself by simply giving a description of it.

The Apparatus must be made as light as possible, either of silver, ivory, or steel; it acts somewhat on the principle of a screw pincushion, which it slightly resembles in shape; it is fixed upon the arm, in the same manner as the pincushion is made fast to the table, viz. by a spiral screw; this screw, has upon its point a tabular circle, which being free, moves independent of the screw, and allows the latter to be regulated without disturbing the former, when in contact with the wrist, whilst the instrument is being adjusted over the artery.

The Sphygmometer is passed through an orifice

or slit, prepared for its reception at the end of an arm, of an elliptical form (being round at the upper, and quite flat at the under surface), to prevent it from turning round *; this arm slides horizontally into an aperture, which is adapted with the utmost nicety to receive it, and possesses the advantage of being adjusted at any point to which it may be required, by means of a small screw placed vertically over it, which, when turned, firmly fixes the arm of the Apparatus into the aperture, and prevents it from advancing or receding, except at the will of the operator.

That part of the Apparatus containing the aperture, into which the horizontal arm slides, is placed perpendicularly, and is made to connect the lower part of the Apparatus with the upper by a spiral screw, which, when turned, either increases or diminishes the distance between the base of the Sphygmometer and the tabular circle.

* The first idea which suggested itself to me was, to have the Apparatus made on the principle of a Bracelet, but the great difficulty of keeping the Sphygmometer in a vertical position induced me to abandon it.

MANNER OF APPLYING THE APPARATUS.

When using the Apparatus, the attention of the Sphygmometrist is first directed to the insertion of the Sphygmometer into the orifice at the end of the elliptical arm, and then to secure the arm in the aperture prepared for it, by tightening the vertical screw ; this being accomplished, he next proceeds to arrange the perpendicular screw, so as to admit of the introduction of the ulnar portion of the wrist of the patient, in order to bring the radial portion between the hemi-spheroidal cup of the Sphygmometer, and the tabular circle of the Apparatus, at the same time giving the arm a slight pronatic inclination, in order to bring the radial artery exactly under the base of the instrument ; he then tightens the screw below the tabular circle, until the requisite degree of pressure is obtained.

E. S. B.

The improved Sphygmometer and the Apparatus are to be had of Mr. SQUIRE, Operative Chemist, 227, Oxford Street, corner of Duke Street, Grosvenor Square.

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